

## Identification and Management of Financial, Economical and Energy Risks for Nuclear Power Plant Projects in Small Economy – Case Study Croatia



Željko Tomšić, Marin Cerjan, and Domagoj Puzak participated in Project Activity 5.3.1: Scientific Visit to ANL to work with ANL experts for EMCAS and to check and run improved developed model from the first visit to ANL in 2013. This visit is continuation of activity 5.1.1 Scientific Visit to ANL - Training Course in EMCAS. Results from the improved model were analysed and specific modelling problems were discussed.

Croatian expert team (Željko Tomšić, Faculty of Electrical Engineering and Computing; Marin Cerjan, HEP Trade Ltd.; Domagoj Puzak, Hrvatska Elektroprivreda d.d.) underwent training course at Argonne National Laboratory in EMCAS as a part of our projects. Croatian team covers wide range of activities in domestic and regional power system – from everyday trading of electricity, cross-border capacities and emission allowances, consumption forecasting, production and maintenance planning, water management to strategic research and development of new energy projects.

The training course was led by Mr. Gunter Conzelmann and supervised by Prakash R. Thimmapuram in the Center for

Energy, Environmental, and Economic Systems Analysis at Argonne National Labs. We used the agent-based model EMCAS to model and simulate Croatian and Southeastern Europe regional power system. Techniques we used included:

- Complex-adaptive systems approach to represent agent learning and adaptation;
- Utility function characterization of agent objectives;
- Heuristic optimization for unit commitment;
- Demand response functions to reflect consumer reaction;
- Transmission load flow analysis.

The training was important for meet the following needs of the project objectives:

- developing long-term model for Croatian Electricity System;
- long term emission scenarios for electricity sector in Croatia;
- simulation of electricity market;
- short-term model of market in Croatia in EMCAS mode;
- developing model of Croatian power system long-term development for next 30-50 years;
- analyze electricity market in Croatia and especially to model and analyze influence of Southeast Europe region power electricity market to and possible role of potential new nuclear power plants to Croatia and Southeast Europe.

Developed model can answer on questions at to how to:

- maximize company revenues,
- optimize hydro and thermal generation,
- consider firm contracts and IPP agreements,
- estimate regional economic clearing price of energy,
- simulate spot market transactions,
- quantify operational costs and revenues of an IPP,
- and model energy exchange agreements.

Developed model can be used in Croatia but also as base for development of more detailed model for Southeast Europe interconnected power systems (with experts from other MS) and especially to analyze potential new nuclear power plant as regional project.

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